IN THE UNITED STATES

PATENT AND TRADEMARK OFFICE

Patent Application

Inventor: Kai H. Chang
David Kalish
Thomas J. Miller

Case: 6-17-28

Serial No.: 10/620,068 **Group Art Unit:** 1731

Filed: July 15, 2003

Examiner: Hoffmann, John M

Title: Method And Apparatus For Fabricating Optical Fiber Using Deuterium Exposure

COMMISSIONER FOR PATENTS
P.O. Box 1450
ALEXANDRIA, VA 22313-1450

DECLARATION OF KAI H. CHANG UNDER 37 C.F.R. §1.131

Sir:

I, Kai H. Chang, state that:

1. I am over the age of twenty-one (21) years. I am not suffering from any disabilities, I am competent to make this Declaration, and have personal knowledge of the facts set forth herein.
2. I am a co-inventor of the subject matter disclosed, and claimed, in the above-referenced patent application.
3. The invention was conceived at least as early as May 31, 2000, the date on which I sent an electronic mail message to co-inventor David Kalish disclosing deuterium treatment at room temperature and asking whether he believed that it was patentable. A true and accurate copy of this email message is attached hereto.

4. During the period of from May 31, 2000, to June 26, 2001, the filing date of the parent application (Serial number 09/891,903, now U.S. Patent 6,776,012) of the above-referenced patent application, I diligently worked to develop the commercial embodiments of the invention that are disclosed and claimed in the patent application.

I HEREBY DECLARE that all statements made herein of my own knowledge are true, and that all statements made on information and belief are believed to be true, and that these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that any such willful false statements may jeopardize the validity of the above-referenced patent application, or any patent issued thereon.

Kai Hsiu Chang

Kai H. Chang, Ph. D.

6/22/05

Date

Chang, Kai (Kai)

From: Chang, Kai H (Kai)
Sent: Wednesday, May 31, 2000 6:01 PM
To: Kalish, David (David)
Subject: RE: Deuterium loaded fiber

Dave,

The peak wavelengths of deuteroxyl (OD) and its various overtones are shifted up by about 1.4 (i.e. the square root of the ratio of deuterium to hydrogen mass, 2 [or more precisely, the ratio of the effective masses in the center of mass OH/OD systems, (32x17)/(18x16)]). So the 1380, 1240, and 950 nm OH overtone peaks are respectively shifted to 1850, 1660, and 1260 nm for OD. The intensity ratio of the three peaks are about 1: 1/15 : 1/40.

What had been done and discussed in literature/patents involve high temperature (150 to 1500 C) D2 treatment of tubes, preforms, soot bodies, and fibers. Most aimed to exchange (substitute), to the largest extent possible, the OH already formed in the glass or soot with D2 to form OD. Some aimed to treat fiber in D2 at high temperature (150 C) to tie up (immunize) defects with D2 reaction so that they will no longer be available to H2 reaction upon subsequent exposure to H2 in service.

I believe the biggest problem our partner has is the OH hydrogen aging loss problem. A good fraction of their initial loss probably meets the AllWave spec so that they don't have to do the OH -> OD exchange at high temperature during the preform processing. So in view of the extremely reactive Si defects, D2 treatment of drawn fiber at room temperature for several days would make sense. Instead of OH formation, most of these reactive Si defects will be tied up as OD in this treatment and become unavailable for H2 reaction later. I have not seen this (low temperature D2 fiber treatment) being discussed in literature/patents, but, reading between the lines, I guess this is what our partner is doing. The open question becomes: for D2 treated fiber, in the presence of low levels of H2 at low temperatures (i.e. under service conditions) will OD exchange back to OH over the life time of cable, say 25 years? I think we need to answer such question by experiments before we are sure D2 treatment solves the hydrogen aging problem for AllWave. Furthermore, D2 is expensive (natural abundance of D2 is only 0.015%; think heavy water) so to do a large scale D2 treatment post-draw or during draw will increase the fiber cost.

There are some interesting ways to apply D2 treatment at relatively low temperatures: (1) applying a small amount of D2 at draw tower just before the coating cup while the fiber is still warm, (2) applying D2 in a large sealed chamber that can hold many spools and capable of recovering D2 and (3) applying a small amount of D2 during the ribboning/cabling of AllWave [Remember, recently we discovered that during the normal ribboning and cabling of AllWave, the small amount of H2 outgassed from the cable/ribbon material was sufficient to induce the OH aging loss increase to reach saturation and to cause a good fraction of the AllWave fibers in the cable to fail the 0.31 dB/km loss spec. So as long as we apply D2 at a greater concentration than the H2 outgassing, OD formation will be favored over that of OH]. D2 treatment may also work to eliminate the 1530 nm SiH aging loss problem (as sometimes seen in fibers with peroxy defects) by the SiD formation.

Some of the ideas above may be patentable. Comments?

Kai

-----Original Message-----
From: Kalish, David (David)
Sent: Tuesday, May 30, 2000 8:26 AM
To: Chang, Kai H (Kai)
Subject: Deuterium loaded fiber
Importance: High

Kai:

Did you save the spectral loss curves for deeuterium loaded fibers? Where are the peaks? ARe there any aging issues with deuterium loaded fiber. What about he cost? Any probelm with jsut loading fiber in dehydration of sintering steps?

dave

David Kalish, Ph.D.

Director, Fiber Development & Engineering
Bell Laboratories
Lucent Technologies, Inc.
tel:770-798-2650